8.1 rate of reaction

Rate of reaction: the speed at which a chemical reaction takes place, has units mol dm^{-3} s^{-1}

$$ROR = \frac{change\ in\ amount\ of\ reactants\ or\ products\ (mol\ dm^{-3})}{time\ (s)} = gradient\ of\ a\ \frac{concentration}{time}\ graph$$

Frequency of collisions: amount of collisions occurring per unit time

Effective collisions: two species collide with energy equal to or more than energy needed for bonds to break (activation energy) and with the correct orientation

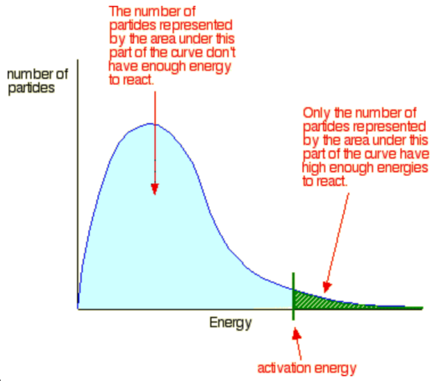
Non-effective collisions: when two species collide with energy less than the energy needed for bonds to break or with incorrect orientation

Effect of concentration of rate of reaction:
The more concentrated a solution is, the greater the number of particles in a given volume, an increase in concentration causes an increase in collision frequency thus an increased rate of reaction, this is as there are more particles so the likelihood of two particles colliding with sufficient energy and in a correct orientation is higher

Effect of pressure on rate of reaction:
An increase in pressure in reactions that involve gases have the same effect as in increase in concentration of solutions, this is as when pressure is increased, the molecules have less space is which they can move, this means that more collisions occur per unit time increasing the likelihood of successful collisions occurring, increasing the rate of reaction

8.2 Effect of temperature on reaction rates and the concept of activation energy

Activation energy: the minimum energy required for a collision to be effective



Boltzmann distribution curve:
Shows the energy in gas particles
Graph must start at 0,0 as no particles have zero kinetic energy
Area under the curve is equal to the total number of molecules
The peak of the curve is the most likely energy of a particle in the sample
Activation energy is labeled usually with a dashed line
The area after the activation energy are all the particles with sufficient energy to react

Effect of energy on rate of reaction:
As the temperature increases, the particles have more KE on average which means that a larger proportion of the molecules will have energy greater than activation energy so collisions occur more frequently and with more energy, which means that the rate of reaction increased
To display this on a Boltzmann distribution curve, the curve shift to the right, the peak is lower, the area under the curve remains the same, and the area under the curve beyond activation energy increased, it only crosses the initial curve once

8.3 Homogenous and Heterogenous catalysts

Catalyst: a substance that increases the rate of a reaction by providing an alternate pathway that has a lower activation energy, the catalyst is chemically unchanged at the end of reaction

Homogenous catalyst: catalyst is in the same phase as the reactants, such as H2SO4 in ester formation, they work by forming an intermediate by reacting and combining then being reformed again

Heterogenous catalyst: catalyst that is in a different phase from the reactants, such as iron in Haber process. Higher SA of catalyst leads to higher ROR

Advantages: lower operating temperature and temperature, speed up reaction, change properties of product positively such as formation of polyethene, less waste is produced as some reactions would require less steps

On the **Boltzmann curve**, the location of the activation energy moves backwards